

Applicant : Richard E. Smalley *et al.*
Serial No. : 09/935,998
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Attorney's Docket No.: 21753-014601
(formerly 11321-P014US)

Remarks

Claims 36-38, 41-42, 45-59 and 61-64 are pending in the Application.

Claims 36-38, 41-42, 45-59 and 61-64 are rejected.

Claims 46-47, 50 and 62 are amended herein.

L. CLAIM REJECTIONS UNDER 35 U.S.C. § 112, ¶ 1 (WRITTEN DESCRIPTION)

Examiner has rejected Claims 36-38, 41-42, 45-59 and 61-64 under 35 U.S.C. § 112, ¶ 1, as failing to comply with the written description requirement based upon O'Connell *et al.*, "Reversible water-solubilization of single-walled carbon nanotubes by polymer wrapping," *Chem. Phys. Lett.*, 342 (2001) 265-271 ("O'Connell"), Office Action, at 2.

The Examiner contends that "[t]he claims(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention." *Id.* The Examiner contends that "Applicant has not described how poly(methyl methacrylate-co-ethyl acrylate), polyvinyl alcohol, polyethylene glycol, and polyallyl amine can be successfully wrapped on aggregates of SWNT. According to an article authored by Applicant (submitted for publication just 7 months before the filing date of the present application), such polymers have not been found successful in wrapping aggregates of SWNT. See the article by O'Connell *et al.*, "Reversible water-solubilization of single-walled carbon nanotubes by polymer wrapping," page 269, left column...". In addition, the two provisional applications that have been claimed as the priority documents of the present application do not disclose poly(methyl methacrylate-co-ethyl acrylate), polyvinyl alcohol, polyethylene glycol, and polyallyl amine as the coating/wrapping polymers." Office Action, at 2-3.

Applicant traverses these rejections.

The Examiner has apparently misunderstood *O'Connell*, which has led the Examiner to draw erroneous conclusions that form the basis for these rejections. *O'Connell* states:

SWNTs can be successfully solubilized by wrapping with other polymers, including polystyrene sulfonate (PSS), poly(1-vinyl pyrrolidone-co-vinyl acetate), poly(1-vinyl pyrrolidone-coacrylic acid), poly(1-vinyl pyrrolidone-co-dimethylaminoethyl methacrylate), polyvinyl sulfate, poly(sodium styrenesulfonic acid-co-maleic acid), dextran, dextran sulfate, and bovine serum albumin. Other polymers were unsuccessful, including poly(methyl methacrylate-co-ethyl acrylate), polyvinyl alcohol, polyethylene glycol, and polyallyl amine.

O'Connell, at 269, col. 1, Section 3.4, first full paragraph. The Examiner has pointed to the last sentence quoted above in support of the present rejections. See Office Action, at ¶ 4. Contrary to Examiner's paraphrasing, this sentence does not, and did not, state that "such polymers [identified in this sentence] have not been found to be successful in wrapping aggregates of SWNT" and that "coatings of one of poly(methyl methacrylate-co-ethyl acrylate), polyvinyl alcohol, polyethylene glycol, and polyallyl amine on aggregates of SWNT have been unsuccessful." *Id.*, at ¶¶ 4 & 5. Rather, when read in context of the entire paragraph (as well as the entire paper), this last sentence was stating SWNTs, when wrapped with the polymers listed in that sentence, were "unsuccessful" in solubilizing the SWNTs. *O'Connell*, at 269, col. 1, Section 3.4, first full paragraph. This was in direct comparison with the first sentence of this paragraph that stated that SWNTs, when wrapped with the polymers listed in that sentence were "successfully solubilized." *Id.* Therefore, the "success" and "unsuccess" being discussed in this paragraph of *O'Connell* had to do with whether SWNTs wrapped with a particular polymer were "successfully solubilized" or "unsuccessfully solubilized" (and not whether the SWNTs were successfully wrapped). This "success" regarding solubility is consistently used elsewhere in *O'Connell*. See, e.g., *O'Connell*, Abstract, which begins "Single-walled carbon nanotubes (SWNTs) have been solubilized in water by non-covalently associating them with linear polymers, most *successfully* with polyvinyl pyrrolidone (PVP) and polystyrene sulfonate (PSS)." *O'Connell*, at 265 (emphasis added).

Applicant further points out that in the present Application, the Applicant expressly discussed it found that, although the initial testing did not reveal solubilization of the SWNTs wrapped with poly(methyl methacrylate-co-ethyl acrylate), polyvinyl alcohol, polyethylene glycol, and polyallyl amine, subsequent testing did reveal such wrapped SWNTs can be successfully solubilized.

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SWNTs can also be successfully solubilized by wrapping with other polymers, including polystyrene sulfonate (PSS), poly(1-vinyl pyrrolidone-co-vinyl acetate) (PVP/VAc), poly(1-vinyl pyrrolidone-co-acrylic acid), poly(1-vinyl pyrrolidone-co-dimethylaminoethyl methacrylate), polyvinyl sulfate, poly(sodium styrene sulfonic acid-co-maleic acid), dextran, dextran sulfate, and bovine serum albumin (BSA). *Although polymers including poly(methyl methacrylate-co-ethyl acrylate), polyvinyl alcohol, polyethylene glycol, and polyallyl amine were initially unsuccessful in solubilizing SWNT by wrapping, subsequent tests indicated that they can successfully solubilize SWNT by wrapping.*

Applicant, at 24, *ll. 7-13* (emphasis added).

Accordingly, the Examiner's rejection is based upon an apparent misunderstanding of *O'Connell*. As such, and contrary to the Examiner's position, the subject matter is described in the Application in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the Application was filed, had possession of the claimed invention.

In furtherance of the above, Applicant has attached herewith a Declaration of Ken Smith, Ph.D., Under 37 C.F.R. § 1.132 ("Smith Declaration") attesting to the above. Smith Declaration, ¶¶ 2-6. Dr. Smith is one of the named co-inventors of the Application and has confirmed that the processes disclosed in the Application are enabled, including when polymers such as poly(methyl methacrylate-co-ethyl acrylate), polyvinyl alcohol, polyethylene glycol, and polyallyl amine are used. *Id.*

As such Claim 36 and its dependent Claims 37-38, 41-42, 45-59 and 61-64 comply with the written description requirement. In light of the foregoing, Applicant respectfully requests that the Examiner withdraw the rejection of Claims 36-38, 41-42, 45-59 and 61-64 under 35 U.S.C. § 112, ¶ 1.

II. CLAIM REJECTIONS UNDER 35 U.S.C. § 112, ¶ 1 (ENABLEMENT)

Examiner has rejected Claims 37-38 under 35 U.S.C. § 112, ¶ 1, as failing to comply with the enablement requirement. The Examiner contends that the "claim(s) contain subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it

pertains, or with which it is most nearly connected, to make and/or use the invention.” Office Action, at 3.

The Examiner contends that “[t]he specification as originally filed does not provide support for uncoated single-wall carbon nanotubes that are substantially aligned along their longitudinal axes. As disclosed in the original specification, particularly page 13, lines 19-26; page 17, lines 11-18; and page 19, lines 23-27, uncoated carbon nanotubes form ropes or bundles, i.e. longitudinally non-aligned.” Office Action, at 3. The Examiner further contends that “[t]he only way to align them longitudinally is to coat (or wrap) individual carbon nanotubes with a polymer; that is, the only carbon nanotubes that are aligned along their longitudinal axes are nanotubes that have been individually polymer-coated or -wrapped.” *Id.*

Applicant traverses these rejections.

Claim 36 covers a composition wherein an aggregate of uncoated single-wall carbon nanotubes is wrapped in one or more of the polymers recited in Claim 36. Thus, while the aggregate is coated, the aggregate is made up of uncoated single-wall carbon nanotubes. Claim 37, which depends from Claim 36, adds the additional limitation “wherein the aggregate of uncoated single-wall carbon nanotubes comprises a rope of single-wall carbon nanotubes in which the nanotubes are substantially aligned along their longitudinal axes.” Claim 38, which also depends from Claim 36, adds the additional limitation “wherein the aggregate of uncoated single-wall carbon nanotubes comprises a bundle of single-wall carbon nanotubes in which the nanotubes are substantially aligned along their longitudinal axes.”

As to Claims 37-38, the Examiner appears to be taking the position that ropes and bundles of uncoated single-wall carbon nanotubes are aggregates of longitudinally non-aligned single-wall carbon nanotubes. Office Action, at 3. In support of this, Examiner has pointed to page 13, lines 19-26, page 17, lines 11-18 and page 19, lines 23-27.² Applicant has reviewed these passages, and these

² Applicant notes that Examiner may have meant the last cite to be page 18, lines 23-27, of the Application. This passage equally fails to support Examiner's position.

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do not support Examiner's position. Moreover, Applicant was unable to find any portion in the Application supporting Examiner's position.

To the contrary, the Application states the following:

An improved method of producing single-wall nanotubes is described in U.S. Pat. No. 6,183,714, entitled "Method of Making Ropes of Single-Wall Carbon Nanotubes," incorporated herein by reference in its entirety. This method uses, *inter alia*, laser vaporization of a graphite substrate doped with transition metal atoms, preferably nickel, cobalt, or a mixture thereof, to produce single-wall carbon nanotubes in yields of at least 50% of the condensed carbon. The single-wall nanotubes produced by this method are much more pure than those produced by the arc-discharge method. Because of the absence of impurities in the product, the aggregation of the nanotubes is not inhibited by the presence of impurities and *the nanotubes produced tend to be found in clusters, termed "ropes," of 10 to 5000 individual single-wall carbon nanotubes in parallel alignment*, held together by van der Waals forces in a closely packed triangular lattice.

Application, at 4, *ll. 1-11* (emphasis added).

Thus, as expressly stated in the Application, the processes disclosed and described in U.S. Pat. No. 6,183,714 ("the '714 Patent," which the Application incorporated in its entirety), teaches a method of making a rope of single-wall carbon nanotubes. *Id.* The term "rope" is expressly defined in the Application as an aggregate of 10 to 5000 individual single-wall carbon nanotubes *in parallel alignment*, held together by van der Waals forces in a closely packed triangular lattice. As the aggregate of single-wall carbon nanotubes in the rope are in "parallel alignment," this means the single-wall carbon nanotubes in the rope are "are substantially aligned along their longitudinal axes."³ Hence, the '714 patent teaches how to make an aggregate of uncoated single-wall carbon nanotubes wherein the "aggregate of uncoated single-wall carbon nanotubes comprises a rope of single-wall carbon nanotubes in which the nanotubes are substantially aligned along their longitudinal axes," which aggregate meets the additional limitation of Claim 37.

³ As stated in the Application, carbon nanotubes are "substantially aligned along their longitudinal axis" when they are within 25° of having parallel longitudinal axes. Application, at 17, *ll. 5-7*.

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The processes disclosed and described in this incorporated the '714 patent likewise teach how to make an aggregate of uncoated single-wall carbon nanotubes wherein the "aggregate of uncoated single-wall carbon nanotubes comprises a bundle of single-wall carbon nanotubes in which the nanotubes are substantially aligned along their longitudinal axes," which aggregated meets the additional limitation of Claim 38. The '714 patent shows a process to make "bundles of single-wall carbon nanotubes, again showing the generally parallel nature of each single-wall nanotube with other single-wall carbon nanotubes in the same bundle." '714 Patent, col. 12, ll. 10-31 & Fig. 2C.

Applicant further notes the Application expressly states that SWNT used in the invention can be produced by the methods disclosed in the '714 Patent.⁴

Accordingly, the Examiner is incorrect in stating that the Applicant does not teach how to make the aggregates of single-wall carbon nanotubes as required by Claims 37-38. Rather, as shown above, Claims 37-38 each comply with the enablement requirement.

In light of the foregoing, Applicant respectfully requests that the Examiner withdraw the rejection of Claims 37-38 under 35 U.S.C. § 112, ¶ 1.

III. REJECTIONS UNDER 35 U.S.C. §102(f)

Examiner has rejected Claims 36-38, 41-42, 45-59 and 61-64 under 35 U.S.C. § 102(f) as being disputed by Applicant's own publication, *O'Connell*, Office Action, at 4.

The Examiner contends that *O'Connell* "was submitted for publication on January 2001 (about seven months before the filing date of the present application). According to *O'Connell*,

⁴ Applicant notes that other patent applications are disclosed in the Application that disclose additional methods for producing SWNT. See Application, at 4, l. 12 – 5, l. 16 & at 16, ll. 15-17. Such patent applications reveal alternative methods to make aggregates of single-wall carbon nanotubes comprising ropes and bundles that meet the added limitations of Claims 37-38, respectively. For instance, PCT Application No. PCT/US99/21367 (incorporated in its entirety in the Application , at 5, ll. 6-16) states: "SWNT produced by the method of this invention are substantially free of amorphous or pyrolytic carbon . . . The single-wall carbon nanotubes may be aggregated in 'ropes' or bundles of essentially parallel nanotubes." PCT/US99/21367, at 14, l. 31 – 15, l. 7.

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"coatings of one of poly(methyl methacrylate-co-ethyl acrylate), polyvinyl alcohol, polyethylene glycol, and polyallyl amine on aggregates of SWNT have been unsuccessful." *Id.* Examiner further contends that "[T]here is no evidence that Applicant had managed to overcome such limitation at the time this application was filed. Thus, Applicant did not invent the claimed composition." *Id.*

Applicant traverses these rejections.

As discussed in detail above, the Examiner has apparently misunderstood *O'Connell*, which misunderstanding has likewise led the Examiner to incorrectly reject these claims under § 102(f). Contrary to Examiner's position, *O'Connell* does not, and did not state "coatings of one of poly(methyl methacrylate-co-ethyl acrylate), polyvinyl alcohol, polyethylene glycol, and polyallyl amine on aggregates of SWNT have been unsuccessful." Rather, as discussed above, the process disclosed in the present Application can be and were used to wrap SWNTs in polymers, including poly(methyl methacrylate-co-ethyl acrylate), polyvinyl alcohol, polyethylene glycol, and polyallyl amine. Accordingly, the inventors did invent the claimed compositions, and nothing in *O'Connell* reflects otherwise. Thus, the Examiner's basis for these rejections is flawed.

In light of the foregoing, Applicant respectfully requests that the Examiner withdraw the rejection of Claims 36-38, 41-42, 45-59 and 61-64 under 35 U.S.C. § 102(f), as being disputed by Applicant's own publication, *O'Connell*.

IV. OTHER CLAIM AMENDMENTS

Claims 46-47 and 62 are amended herein to correct grammatical errors.

Claim 50 is amended herein to include the words "aggregate of" before "single-wall carbon nanotubes."

No new matter is added by virtue of these amendments.

V. CONCLUSION

As a result of the foregoing, it is asserted by Applicant that the Claims in the Application are now in a condition for allowance, and respectfully requests allowance of such Claims.

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Applicant respectfully requests that the Examiner call Applicant's attorney at the below listed number if the Examiner believes that such a discussion would be helpful in resolving any remaining problems.

Respectfully submitted,

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